HAY-FEVER

LEDERLE ANTITOXIN LABORATORIES NEW YORK

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HAY-FEVER

Lederle Antitoxin Laboratories, Pearl River, Rockland County, N. Y.,
where the original work of preparing glycerolated pollen antigens in stable and standardized solution was carried out in 1914.

HAY-FEVER

ITS DIAGNOSIS AND TREATMENT
WITH
POLLEN ANTIGENS*

Illustrated with
forty-one engravings

LEDERLE ANTITOXIN LABORATORIES
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* The name "Pollen Antigen" denotes the product of the Lederle Antitoxin Laboratories

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PREFACE

THE object of this little book is to give the busy practitioner the important facts concerning the pollens that cause hay-fever; to explain to him briefly the approved methods of making diagnostic tests and administering the pollen treatment; and to provide him with a handy reference so that he may readily know the various pollens causing hay-fever at different seasons of the year in his own locality.

In submitting this book to the medical profession, our aim has been to state concisely and accurately the present understanding concerning the clinical application and value of the pollen therapy of hay-fever; and to present the subject in such a manner as to be of the most assistance to the practitioner.

A special study has been made of the botanical flora in each section of the country, and the hay-fever pollens of primary and secondary importance in the different geographical areas have been tabulated according to their season of pollination.

The line drawings of cocklebur (*page 10*), giant ragweed (*page 4*), marsh elder (*page 7*), mugwort (*page 16*), ragweed (*page 2*), sage brush (*page 14*), sheep sorrel (*page 28*), spiny amaranth (*page 30*),

Western ragweed (*page 5*), Western water hemp (*page 33*), and yellow dock (*page 29*), are from ADA GEORGIA's "Manual of Weeds," published by the Macmillan Company, New York. We wish to express here our thanks for the kind permission to reproduce these copyrighted drawings. The photo-engravings of the grasses (*pages 17 to 22*) are from Farmer's Bulletin, "Important Cultivated Grasses," published by the United States Department of Agriculture, through whose courtesy they are here reproduced. The photographs of the oak (*page 36*) and cottonwood (*page 38*) trees are published by courtesy of the United States Forest Service. The other photographs are original and most of them were especially made for this book.

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HAY-FEVER

Chapter I

Relation of Pollens to Hay-Fever

The records of the American Hay-Fever Prevention Association[1] show that about 1 per cent of the population of the United States is susceptible to hay-fever (approximately 1,250,000 persons being affected). Because of the nature of its symptoms, hay-fever is probably more dreaded by its victims than many of the more serious diseases. The congestion of the nostrils with profuse nasal discharge, the difficulty of nasal breathing, the itching of the eyes, the sudden and often violent attacks of sneezing and the sleepless nights, to which are frequently added more or less severe asthmatic attacks, form a combination of distressing symptoms which are aggravated by the probability of their annual recurrence.

The medical world is indebted to DUNBAR[2] for the exhaustive scientific proof in 1903 of the specific action of pollen as the cause of hay-fever. DUNBAR's work opened the way to a new method of treatment founded upon immunology. He isolated from the pollen what he thought was a true toxin, but later investigations

[1] SCHEPPEGRELL, W.: Hay-Fever: Its Relation to Seasons, Occupations, Sex and Color, *N. Y. Med. Jour.*, Dec. 9, 1916, p. 1127.

[2] DUNBAR, W. P.: Zur Ursache und Specifischen Heilung des Heufiebers, Muenchen, 1903.

established the fact that the active substances of the pollens are proteins with active antigenic properties.

As early as 1911, medical research workers had successfully treated hay-fever patients with antigenic extracts of pollens. This early work was done with freshly prepared aqueous extracts and no provision was made for the preservation of these extracts in stable form. Hence, the general application of this form of treatment by the practicing physician was not at that time practicable.

Ragweed (*Ambrosia elatior*)

Pollen Antigens (Lederle)

In 1914, researches conducted in the Lederle Antitoxin Laboratories resulted in the perfection of glycerolated pollen antigens in stable and standardized solution. The physician for the first time was thus afforded a means for the scientific treatment of his hay-fever patients.

Pollen Antigens (Lederle) are prepared by extracting the mature pollen grains in 66⅔ per cent glycerol and 33⅓ per cent saturated sodium chloride

solution. This method of preparing Pollen Antigens (Lederle) has been continuously used for ten years, during which time it has proved to produce *uniformly potent and stable pollen antigens.* These antigenic

Flowering top of Ragweed (*Ambrosia elatior*)

solutions are standardized against antipollen serum by the complement fixation method which accurately determines the antigenic activity of the pollen protein. *This ensures an active and potent product.*

Wind-borne Pollens

Hay-fever is a condition of hypersensitiveness to pollen proteins and is produced primarily by the inhalation of wind-borne pollens. However, only those wind-borne pollens that are inhaled during normal respiration cause true hay-fever. Thus, SCHEPPEGRELL[3] says: "While there are many plants whose pollen may cause the hay-fever reaction when applied to the nostrils, *only pollens which float in the air and can reach the nostrils in the course of normal respiration are responsible for true hay-fever.*" This fact was definitely established[4] by means of atmospheric-pollen plates which were exposed daily, during the hay-fever season, at various stations of the American Hay-Fever Prevention Association and also near the residences of the hay-fever patients. The plates were coated with glycerin and exposed for periods of twenty-four hours and then

Giant Ragweed
(*Ambrosia trifida*)

[3] SCHEPPEGRELL, W.: Hay-Fever and Hay-Fever Pollens, *Arch. Int. Med.*, June 15, 1917, p. 959.

[4] SCHEPPEGRELL, W.: Hay-Fever and Its Relation to 100 of the Most Common Plants, Trees and Grasses, *Med. Rec.*, Aug. 11, 1917, p. 230.

taken to the laboratory, stained, examined microscopically and the pollens identified.

Sensitization

Although wind-borne pollen is so widely distributed that the mucous membranes of all persons come in contact with it, yet only those who are sensitized develop hay-fever. Most people can breathe pollens in large amounts with no more irritation than is caused by any other dust. But in the case of a person who is sensitive to pollen, the pollen when inhaled produces symptoms of hay-fever. Each hay-fever patient represents a state of sensitiveness to a definite pollen, as can readily be proved by cutaneous tests with extracts of pollen. Just what causes this sensitiveness is largely unknown; neither do we know exactly why some persons are sensitive to certain pollens while others are not. Many times the sensitiveness to pollen protein increases with an increase in the

Western Ragweed
(*Ambrosia psilostachya*)

amount of pollen inhaled, with naso-pharyngeal disease or obstruction, with the lowering of a person's

Slender Ragweed (*Franseria tenuifolia*)

vitality, and there also seems to exist an hereditary sensitiveness to hay-fever in certain persons. But

the sensitiveness often increases without known cause.

Characteristics of Hay-Fever Pollens

Pollens are carried from one plant to another either through the agency of the wind or by insects. The principal and most important fact in connection with hay-fever is that *only those pollens which are carried by the wind and which are therefore in the air can cause true hay-fever.*

Wind-pollinated plants are distinguished by their inconspicuous flowers which are devoid of scent or odor; their pollen is shed in large amounts and is light and buoyant.

Insect-Borne Pollens

On the other hand, insect-pollinated plants are characterized by their bright-colored, conspicuous flowers which have a sweet scent or odor; their pollen is heavy and viscid and is shed very sparingly. *Insect-pollinated plants are not an important factor in*

Marsh Elder (*Iva ciliata*)

hay-fever, because their pollen is never present in the atmosphere in sufficient amounts to reach

Shad Scale (*Atriplex canescens*)

the nostrils in the course of normal respiration The fact that *true hay-fever is caused by the inhalation*

of wind-borne pollens only, eliminates a long list of insect-pollinated plants which are popularly supposed

Annual Saltbush (*Atriplex Wrightii*)

to cause hay-fever. These insect-pollinated plants comprise alfalfa, clover, roses, dahlia, honey-suckle,

rose of Sharon, chrysanthemum, lily-of-the-valley, aster, spirea, crimson rambler, clematis, lilac, goldenrod, dandelion, white daisy, yellow daisy, sunflower, mountain laurel, (rose bay or oleander), sugar beet, fruit trees (apple, apricot, pear, peach, plum) and several other trees including alder, fir, hemlock, pine, spruce, tamarisk (or flowering cypress) and willow.

Hay-fever in the late spring and early summer is often erroneously designated "rose cold" or "rose fever." Such a name is a misnomer, for hay-fever at this time of year is not caused by rose pollen but by pollen from the grasses. In like manner, fall hay-fever is popularly attributed to pollen of the goldenrod,[5] while in reality it is caused in the vast majority of cases by ragweed.

There are certain insect-pollinated plants whose pollen will undoubtedly produce hay-fever symptoms if

Cocklebur (*Xanthium canadense*)

[5] SCHEPPEGRELL, W.: The Goldenrod Is Not Responsible for Hay-Fever, *U. S. Pub. Health Reports*, July 21, 1916.

directly inhaled, but *such pollens are never found in the air in any great quantity and so are practically not a factor in the hay-fever situation.* The pollen of insect-pollinated plants may precipitate an attack of hay-fever under exceptional circumstances—such, for example, as where the flowers are deliberately smelled as might be done particularly by children, or where the plants are grown in great profusion in close contact with the patient, or even in some cases where the flowers are used for room decoration. But such symptoms would not long persist.

Pollens of Cereal Grains

The pollen of corn, in spite of its toxicity, is rarely responsible for hay-fever; because its size is so great that it cannot travel far; so that only by close proximity to a corn field can hay-fever be induced. Rye and wheat also have large pollen grains and, therefore, are of little practical importance as a cause of hay-fever. The cereals, however, including rye, wheat, oats and corn, may constitute a local cause of hay-fever in some States.

Chapter II

Diagnostic Tests

Sensitiveness to pollens can be determined by applying diagnostic skin tests. For this purpose, extracts prepared from the individual species of pollens that cause hay-fever should be used. Since the botanical flora varies greatly in different sections of the country and with the seasons of the year, it is essential for the physician:

1. To acquaint himself with those plants which are most common in the section where his patients live;
2. To know which plants are wind-pollinated and therefore capable of causing hay-fever;
3. To be familiar with the pollinating (blooming) period of such plants;
4. And to ascertain the exact date when his patient's hay-fever symptoms appear.

From the list of pollens which are known to cause hay-fever in that section (see tables on pages 40 to 55), the physician can readily determine the particular pollen which is responsible for his patient's hay-fever by applying skin tests. The reactions resulting from the skin tests, when interpreted with a knowledge of the above mentioned four essentials, will indicate the pollen to which his patient is most sensitive.

How to Make a Skin Test

Cleanse the flexor surface of the forearm with alcohol or ether and grasp the outer surface of the forearm with the left hand to stretch the skin. With sterile

Flowering top of cocklebur (*Xanthium canadense*)

needle, make two small scarifications each about ⅛-inch long and about 3 inches apart on the flexor sur-

face of the forearm—care being taken not to draw blood, otherwise the pollen diagnostic will be washed away from the scarified tissue. Place the pollen diagnostic on one of the scarifications and then gently rub it in with the side of the needle. The other scarified area is used as a control to determine the sensitiveness of the skin to mechanical traumatism.

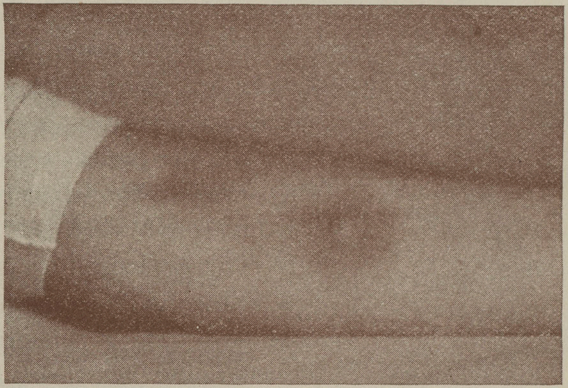
Sage Brush (*Artemisia tridentata*)

Interpretation of Skin Reactions

At the end of a half hour, wash off the pollen diagnostic and note the reaction; and at the same time compare it with the control scarification. The pollens which are not the cause of the patient's hay-fever will produce no reaction, so that the scarifications to which such pollens were applied will look like the control scratch. A positive reaction consists of an urticarial wheal or white raised area of the skin which looks like a hive or mosquito bite surrounding the scarification. The wheal is usually surrounded by a zone of redness.

The degree of the reaction is determined entirely by the size and shape of the urticarial wheal. The surrounding zone of erythema or redness may be disre-

garded. For a reaction to be considered positive, there must be a true urticarial wheal, larger in size than the control reaction. The greater the irregularity in outline of the urticarial wheal, the greater is the sensitiveness of the patient to that particular pollen. Thus, an urticarial wheal with pseudopods (irregular, radiating portions), is of greater significance than a



Diagnostic Skin Test: Positive pollen reaction, showing urticarial wheal surrounded by zone of redness with control scarification to left of red area

wheal having a more or less regular outline without pseudopods. The swollen area (urticarial wheal) may be as large as one to two inches (25 to 50 millimeters) in diameter, but more often is about 5/8-inch (15 millimeters). It is often associated with intense itching of the skin.

This skin test gives absolute proof as to which pollens are the cause of hay-fever in the individual case. *Several skin tests should be made, using those pollens which are known to be most prevalent in the atmosphere at the season when the patient experiences the most severe hay-fever symptoms.* If the patient is affected by several pollens (as indicated by positive skin reactions produced by more than one pollen), the degree of reactions will distinguish between the pollens that affect the patient only slightly and those that are harmful and are responsible for the hay-fever symptoms. It is important to determine by these skin tests which pollen is the principal offender in causing the hay-fever symptoms, and treatment should be given with the pollen antigen corresponding to that pollen which gives the maximum positive reaction in the skin test.

Mugwort (*Artemisia vulgaris*)

Chapter III

Pollen Treatment

CLOWES[6] was the first to report a definite method of vaccination against hay-fever in this country; but to KOESSLER[7] must be given the credit for placing the method of desensitization against hay-fever on a scientific basis, for he was the first to report detailed methods of preparing pollen extracts.

June Grass (Blue Grass, *Poa pratensis*)

Glycerolated Pollen Antigens (Lederle)

With the end in view of devising some method for preparing a uniformly stable product,

[6] CLOWES, G. H. A.: A Preliminary Communication on the Treatment of Autumnal Hay-Fever by Vaccination, *Proc. Soc. Exp. Biol. and Med.*, 10: 70, 1913.

[7] KOESSLER, K. K.: The Specific Treatment of Hay-Fever, *Forchheimer's Therapeusis of Internal Diseases*, New York, D. Appleton & Co., 5: 671, 1914.

we extracted pollen by various methods[8] and succeeded in preparing uniformly stable pollen antigens[9] by extracting the pure, mature pollen grains in 66⅔ per cent glycerol and 33⅓ per cent saturated sodium chloride solution. Such glycerolated pollen antigens proved to be remarkably stable and more potent than those obtained by any other method of extraction, for no loss in antigenic properties could be detected in the glycerolated pollen antigens after being stored in the icebox for twenty-two months.

Timothy (*Phleum pratense*)

Standardization

Moreover, we were able to accurately standardize Pollen Antigens (Lederle) against antipollen serum[10] by means of the complement fixation method, whereby the amount of antigenically active protein in the extract is definitely determined. This ensures their antigenic activity and

[8] Clock, R. O.: Comparative Value of the Methods of Preparing Pollen Antigen, *J. Infec. Dis.*, Dec., 1917, p. 523.

[9] Clock, R. O.: A Stable Pollen Antigen, *J. Infec. Dis.*, Oct., 1917, p. 387.

[10] Clock, R. O.: Antipollen Serum for Standardization of Pollen Antigen, *J. Infec. Dis.*, Jan. 1918, p. 80.

provides for accurate dosage; for the protein in the glycerolated pollen antigens is preserved by the glycerol from autolytic deterioration, so that the original standardization is permanent.

The investigations of the United States Public Health Service [11] into the status of preventive treatment of seasonable hay-fever included an analysis of the various methods of preparing and testing pollen extracts. It will be of interest to physicians that this investigation confirms the work originally carried out in the Lederle Antitoxin Laboratories; also that the method for the preparation and testing of pollen antigens developed in the Lederle Antitoxin Laboratories and reported by Dr. Clock was found satisfactory, as shown by the following excerpt from the published report of the Public Health Service expert:

Redtop (*Agrostis palustris*)

"Clock is deserving of much credit for calling attention to the fact that

[11] Bernton, H. S.: Treatment of Seasonable Hay-Fever and Some Possible Causes of Failure, *Jour. A. M. A.*, May 5, 1923, p. 1301.

chemical analysis fails to demonstrate the antigenic qualities of pollen extracts. Such analysis reveals only the amount of pollen protein present in solution. CLOCK has shown that a practical method of determining the antigenic properties of pollen extract is by means of the complement fixation test. . . . He has, furthermore, devised a method of preparing a stable antigen by the use of concentrated salt solution and glycerol. Pollen extracts, prepared by his method, have remained for fourteen months without loss of complement binding capacity. With his glycerolated pollen antigen, CLOCK obtained relief from symptoms in 84 per cent of 1,578 cases. Our experience is confirmatory of CLOCK's observations."

Orchard Grass (*Dactylis glomerata*)

Prophylactic (Preseasonal) Treatment

(A) For the Average Case

The importance of preseasonal pollen treatment cannot be too strongly emphasized. For successful desensitization, it is essential that the prophylactic treatment with Pollen Antigen (Lederle) be started about six to eight weeks before the date of the expected attack of hay-fever. Having determined by the diagnostic skin test the pollen to which the

person is most sensitive, preseasonal treatment is carried out by giving a complete series of fifteen doses of Pollen Antigen (Lederle) prepared from the corresponding pollen that gave the maximum positive reaction in the diagnostic skin test.

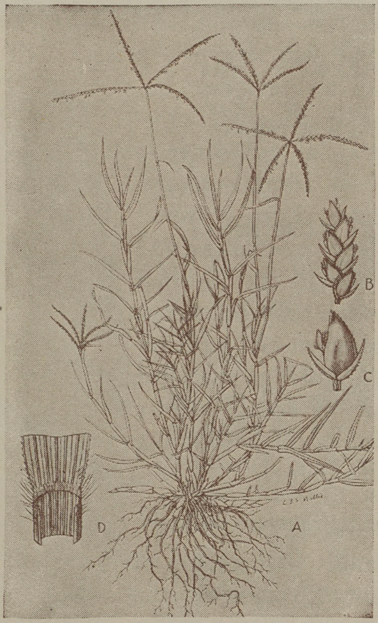
The antigen is administered subcutaneously, preferably in the arm over the insertion of the deltoid muscle. The interval between doses is usually forty-eight hours; a convenient plan being to administer the antigen three times a week. The complete preseasonal treatment should be finished about one week before the date of the usual onset of hay-fever symptoms, in order to complete the schedule of dosage before the beginning of the pollinating season of the plants.

Perennial Rye Grass
(*Lolium perenne*)

(B) Incompletely Protected Cases

In a small percentage of persons (about 10 per cent), the complete prophylactic pollen treatment will fail to establish complete desensitization, and such persons will not be fully protected from hay-fever

symptoms. Under these circumstances, the hay-fever attack may be delayed beyond its usual date of onset; or, the attack may occur at its regular time but the symptoms will be mild and will not last long. For



Bermuda Grass (*Capriola dactylon*)

such persons the following procedure is recommended:

First. If the interval between the completion of the regular fifteen dose treatment and the appearance

of hay-fever symptoms does not exceed two weeks, additional treatment may be given by injecting four or five extra doses of dose 15 at intervals of two or three days.

Johnson Grass (*Sorghum halepense*)

Second. If an interval of more than two weeks has elapsed, it is advisable to begin the additional treatment with dose 11 and progressively increase the doses

at intervals of one or two days until finally four or five doses of dose 15 have been given.

Lambs Quarters (*Chenopodium album*)

(C) Hypersensitive Cases

A few persons (less than 1% of the cases reported) may be unusually sensitive to pollen protein, so that

in the course of the pollen treatment some dose may produce a severe reaction. Such persons may often be successfully treated by injecting only one-

Flowering top of Lambs Quarters
(*Chenopodium album*)

half or one-quarter of each of the remaining doses, depending upon the reactions produced. After dose 15 has been reached and a fraction of it administered,

the pollen treatment should be continued by injecting increasing amounts of dose 15 until finally the full amount of dose 15 is given. It is also often advisable to increase the interval between doses, especially if the reaction from the previous dose has not subsided.

(D) Refractory Cases

In treating refractory cases—that is, those persons who in previous years have been benefited by the pol-

Rabbit Bush (*Franseria deltoidea*)

len treatment but who have not derived entire relief from their hay-fever symptoms—the degree of protection may be materially increased by starting the pollen treatment ten weeks before the hay-fever season, and administering five or six extra doses of dose 15 at five-day intervals after the regular treat-

ment of fifteen doses has been finished. This plan permits completing the regular treatment and the supplemental treatment with the extra doses before the date of the expected hay-fever attack.

Treatment of Attack

Preseasonal treatment yields by far the most satis-

Flowering top of Rabbit Bush (*Franseria deltoidea*)

factory results and the physician should always impress upon his patient the advisability of taking the pollen treatment in advance of the hay-fever season. Nevertheless, many patients do not apply to their physician for relief from hay-fever symptoms until the actual attack of hay-fever has already begun.

In treating an attack of hay-fever, it is important always to start with dose 1; for it must be borne in mind that the patient is already absorbing pollen from the atmosphere and if the higher doses of pollen antigen are used at first, the hay-fever symptoms may be temporarily aggravated and the patient's condition rendered worse instead of better.

The doses may be progressively increased and as many doses given as may be needed to control the attack. It may be necessary to administer the complete series of fifteen doses before the symptoms entirely disappear in some patients. Others may be benefited by three or four doses, with complete cessation of hay-fever symptoms after the eighth or ninth dose. Usually, the doses may be given at intervals of two or three days. If any dose causes a severe reaction—as shown by an increase in the hay-fever symptoms—it is advisable to inject only one-half or even one-quarter

Sheep Sorrel (*Rumex acetosella*)

of each of the subsequent doses, depending upon the degree of reaction.

Yellow Dock
(*Rumex crispus*)

When used during the attack of hay-fever, Pollen Antigen (Lederle) has in many cases alleviated the condition, as indicated by the symptoms being milder and the attack shorter. The physician can do much to advance the science of the pollen treatment of hay-fever if he will use the opportunity afforded him, when administering pollen treatment during an attack of hay-fever, to impress his patient with the possibility of greater benefit to be derived from preseasonal treatment in the following year.

Chapter IV

Dosage

In the application of desensitization to hay-fever, it is important to always begin with small doses. The experiments of Weil[12] have proved that small amounts of proteins injected repeatedly will desensitize against small amounts, whereas the injection of large amounts of proteins will desensitize against large amounts. Hence, the method of gradually increasing the dose is theoretically correct and the person must be rendered refractory to large doses about the time of the expected attack of hay-fever. In its practical application this method has been proved to be correct.

Spiny Amaranth
(*Amaranthus spinosus*)

[12] Weil, R.: Experiments in Antisensitization: A Contribution to Cellular Dynamics in Immunity, *Ztschr. f. Immunitätsforsch. u. exper. Therap.*, 23: 1 (No. 1), 1914,

The scheme of dosage which we adopted for the glycerolated pollen antigens consists of 15 doses of a gradually increasing number of pollen units; the pollen unit

Redroot Pigweed (*Amaranthus retroflexus*)

having been established by Noon[13] who defined it as the equivalent of one millionth gram of pollen.

[13] Noon, L.: Prophylactic Inoculation against Hay-Fever, *The Lancet*, June 10, 1911, p. 1572.

The actual strength of the various doses is as follows:

Dose 1 contains	2½	pollen units (1 to 40,000 dilution)
Dose 2 contains	5	pollen units (1 to 20,000 dilution)
Dose 3 contains	10	pollen units (1 to 10,000 dilution)
Dose 4 contains	20	pollen units (1 to 5,000 dilution)
Dose 5 contains	25	pollen units (1 to 4,000 dilution)
Dose 6 contains	30	pollen units (1 to 3,500 dilution)
Dose 7 contains	50	pollen units (1 to 2,000 dilution)
Dose 8 contains	75	pollen units (1 to 1,500 dilution)
Dose 9 contains	100	pollen units (1 to 1,000 dilution)
Dose 10 contains	150	pollen units (1 to 700 dilution)
Dose 11 contains	250	pollen units (1 to 400 dilution)
Dose 12 contains	375	pollen units (1 to 300 dilution)
Dose 13 contains	500	pollen units (1 to 200 dilution)
Dose 14 contains	750	pollen units (1 to 150 dilution)
Dose 15 contains	1000	pollen units (1 to 100 dilution)

Densitization Not Permanent

Since hay-fever is not an infectious disease but rather a state of hypersensitiveness to pollen protein, it is impossible to produce a true immunity against it. Cooke[14] and others[15] have pointed out that desensitization in hay-fever is not permanent or stable; freedom from symptoms lasts only as long as the antigen remains in combination with the tissue-antibodies. The state of desensitization is probably complete for only a few weeks after completion of the antigen treatment and gradually diminishes. Hence, it is essential to administer Pollen Antigen (Lederle) each year just previous to the hay-fever season in order to protect the person from hay-fever.

14 Cooke, R. A., Flood, E. P., and Coca, A.: Hay-Fever. The Nature of the Process and the Mechanism of the Alleviating Effect of Specific Treatment, *J. Immunol.*, Feb., 1917, p. 217.

15 Freeman, J.: Further Observations on the Treatment of Hay-Fever by Hypodermic Inoculation of Pollen Vaccine, *The Lancet*, Sept. 16, 1911, p. 814.

Chapter V

Clinical Results

Pollen Antigens (Lederle) were first prepared in 1914 and were described [16] in 1917. They have been used by physicians in all parts of the United States as well as Canada, Central America, Cuba, Porto Rico, South America, New Zealand, Australia, Canary Islands, Philippine Islands, China, British Isles, Norway, Sweden, Denmark, Holland, France, Italy, Czecho-Slovakia, Bulgaria, South Africa, etc.

Western Water Hemp
(*Acnida tamariscina*)

It has been clinically demonstrated that hay-fever can, in many cases, be prevented or alleviated by treatment with the glycerolated pollen antigen prepared from the particular pollen to which the

[16] Clock, R. O.: A Stable Pollen Antigen, *J. Infec. Dis.*, Oct., 1917, p. 387.

person is sensitive. In 1922, CLOCK reported[17] an analysis of 1,578 clinical reports from physicians in all sections of the United States who had used the

Careless Weed (*Amaranthus palmeri*)

glycerolated pollen antigen during five consecutive years. This analysis shows an average protection or relief from hay-fever symptoms in 84 per cent

[17] CLOCK, R. O.: Hay-Fever and Its Treatment with Glycerolated Pollen Antigen, *Jour. Med. Soc., New Jersey*, March, 1922, p. 63.

of cases with a remarkable uniformity of favorable results each year in every locality.

During the past ten years, Pollen Antigens (Lederle)

Flowering top of Careless Weed
(*Amaranthus palmeri*)

have been used for the treatment of hay-fever in more than 55,000 cases. When the complete prophylactic series (doses 1 to 15) of pollen antigen has been ad-

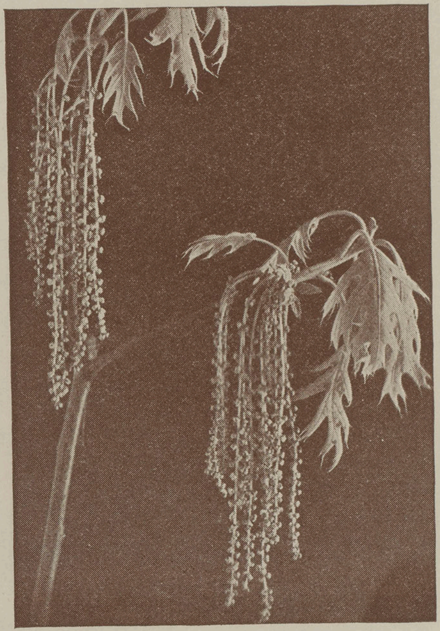
ministered beginning about six weeks before the date of the usual attack of hay-fever, the results reported as favorable showed complete freedom from symptoms of hay-fever; or in those cases in which hay-fever did

Oak tree (*Quercus alba*)

develop, the symptoms persisted for a few days only and were mild in character. Favorable results were also manifested in the possibility of the patient remaining in his home town and at his usual work during the hay-fever season for the first time in years.

Advantages of Pollen Antigen (Lederle) Treatment

The method of giving prophylactic injections of glycerolated pollen antigen early in the season seems



Oak blossoms (*Quercus alba*)

to offer the best means of any method thus far advanced for the preventive treatment of hay-fever. It is no longer necessary to forsake one's business during

the summer months and retire outside the zone of the offending pollinating plants. This was formerly the only rational therapeutic measure, but it was also expensive and time consuming. With the glycerolated pollen antigen treatment, however, the majority

Cottonwood tree (*Populus macdougali*)

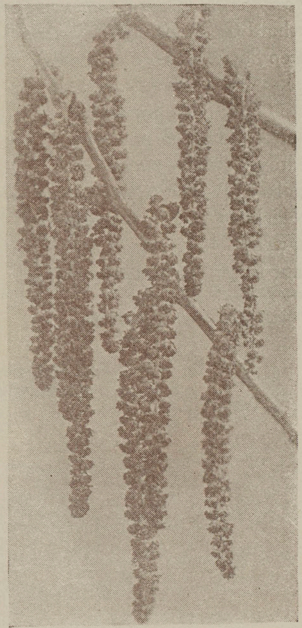
of hay-fever sufferers can be successfully desensitized and can continue to transact their business in their accustomed surroundings. Hence, the value of the glycerolated pollen antigen treatment would seem to be definitely established.

Chapter VI

Causes and Seasons of Hay-Fever

United States

The hay-fever seasons vary in different sections of the country, being dependent upon the flowering periods of the various hay-fever plants which are governed by climatic conditions. In the following tables, the most important pollens from a hay-fever stand-point are indicated by an asterisk (*). The others are usually of secondary or minor importance, except possibly in certain localities where they may assume primary importance.



Cottonwood blossoms
(*Populus macdougali*)

New England States

(Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut)

NAME	TIME OF BLOOM (Hay-Fever Season)
Black Walnut (*Juglans nigra*)	March to May
Cottonwood (*Populus macdougali*)	April to May
Oak (*Quercus alba*)	April to May
Sweet Vernal Grass (*Anthoxanthum odoratum*)	April to July
Orchard Grass (*Dactylis glomerata*)	April to August
Sheep Sorrel (*Rumex acetosella*)	May to July
Yellow Dock (*Rumex crispus*)	May to July
*June Grass (*Poa pratensis*)	May to September
*Timothy (*Phleum pratense*)	June to August
*Redtop (*Agrostis palustris*)	June to September
Lambs Quarters (*Chenopodium album*)	June to September
Cocklebur (*Xanthium canadense*)	July to September
*Ragweed (*Ambrosia elatior*)	August to October
*Giant Ragweed (*Ambrosia trifida*)	August to October

*Pollens of primary importance.

For index of States and other countries, see page 61

Eastern States

(New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, West Virginia)

NAME	TIME OF BLOOM (Hay-Fever Season)
Black Walnut (*Juglans nigra*)	March to May
Cottonwood (*Populus macdougali*)	April to May
Oak (*Quercus alba*)	April to May
Sweet Vernal Grass (*Anthoxanthum odoratum*)	April to July
Orchard Grass (*Dactylis glomerata*)	April to August
Sheep Sorrel (*Rumex acetosella*)	May to July
Yellow Dock (*Rumex crispus*)	May to July
*June Grass (*Poa pratensis*)	May to September
*Timothy (*Phleum pratense*)	June to August
*Redtop (*Agrostis palustris*)	June to September
Lambs Quarters (*Chenopodium album*)	June to September
Cocklebur (*Xanthium canadense*)	July to September
*Ragweed (*Ambrosia elatior*)	August to October
*Giant Ragweed (*Ambrosia trifida*)	August to October

*Pollens of primary importance.

For index of States and other countries, see page 61

Southern States

(North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, Texas)

NAME	TIME OF BLOOM (Hay-Fever Season)
Mountain Cedar (*Juniperus sabinoides*)	December to February
The mountain cedar is found over a considerable part of Texas, Mexico and part of New Mexico	
Cottonwood (*Populus macdougali*)	February to April
Black Walnut (*Juglans nigra*)	March to May
Oak (*Quercus alba*)	April to May
Sweet Vernal Grass (*Anthoxanthum odoratum*)	April to July
Orchard Grass (*Dactylis glomerata*)	April to August
Perennial Rye Grass (*Lolium perenne*)	May to July
Sheep Sorrel (*Rumex acetosella*)	May to July
Yellow Dock (*Rumex crispus*)	May to July
*June Grass (*Poa pratensis*)	May to September
*Bermuda Grass (*Capriola dactylon*)	May to September
*Timothy (*Phleum pratense*)	June to August
*Redtop (*Agrostis palustris*)	June to September
Spiny Amaranth (*Amaranthus spinosus*)	June to September
Lambs Quarters (*Chenopodium album*)	June to September
*Johnson Grass (*Sorghum halepense*)	June to October
Cocklebur (*Xanthium canadense*)	July to September
Redroot Pigweed (*Amaranthus retroflexus*)	July to September
Careless Weed (*Amaranthus palmeri*)	July to October
*Ragweed (*Ambrosia elatior*)	August to October
*Giant Ragweed (*Ambrosia trifida*)	August to October
Marsh Elder (*Iva ciliata*)	August to October

*Pollens of primary importance.

For index of States and other countries, see page 61

Central States

(Kentucky, Ohio, Indiana, Michigan, Illinois, Wisconsin)

NAME	TIME OF BLOOM (Hay-Fever Season)
Black Walnut (*Juglans nigra*)	March to May
Cottonwood (*Populus macdougali*)	April to May
Oak (*Quercus alba*)	April to May
Sweet Vernal Grass (*Anthoxanthum odoratum*)	April to July
Orchard Grass (*Dactylis glomerata*)	April to August
Sheep Sorrel (*Rumex acetosella*)	May to July
Yellow Dock (*Rumex crispus*)	May to July
*June Grass (Blue Grass, *Poa pratensis*)	May to September
*Timothy (*Phleum pratense*)	June to August
*Redtop (*Agrostis palustris*)	June to September
Spiny Amaranth (*Amaranthus spinosus*)	June to September
Lambs Quarters (*Chenopodium album*)	June to September
Annual Saltbush (*Atriplex Wrightii*)	July to September
Redroot Pigweed (*Amaranthus retroflexus*)	July to September
Cocklebur (*Xanthium canadense*)	July to September
Careless Weed (*Amaranthus palmeri*)	July to October
*Ragweed (*Ambrosia elatior*)	August to October
*Giant Ragweed (*Ambrosia trifida*)	August to October
Western Ragweed (*Ambrosia psilostachya*)	August to October

*Pollens of primary importance

For index of States and other countries, see page 61

Middle Western States

(Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas)

NAME	TIME OF BLOOM (Hay-Fever Season)
Black Walnut (*Juglans nigra*)	March to May
Cottonwood (*Populus macdougali*)	March to May
Oak (*Quercus alba*)	April to May
*Sweet Vernal Grass (*Anthoxanthum odoratum*)	April to July
Orchard Grass (*Dactylis glomerata*)	April to August
Sheep Sorrel (*Rumex acetosella*)	May to July
Yellow Dock (*Rumex crispus*)	May to July
*June Grass (Blue Grass, *Poa pratensis*)	May to September
*Timothy (*Phleum pratense*)	June to August
Redtop (*Agrostis palustris*)	June to September
Spiny Amaranth (*Amaranthus spinosus*)	June to September
Lambs Quarters (*Chenopodium album*)	June to September
Annual Saltbush (*Atriplex Wrightii*)	July to September
Redroot Pigweed (*Amaranthus retroflexus*)	July to September
*Sage Brush (*Artemisia tridentata*)	July to September
Cocklebur (*Xanthium canadense*)	July to September
Careless Weed (*Amaranthus palmeri*)	July to October
*Green Sage (*Artemisia canadensis*)	July to October
*Pasture Sage (*Artemisia frigida*)	July to October
Western Water Hemp (*Acnida tamariscina*)	July to October
*Ragweed (*Ambrosia elatior*)	August to October
*Giant Ragweed (*Ambrosia trifida*)	August to October
*Western Ragweed (*Ambrosia psilostachya*)	August to October
Marsh Elder (*Iva ciliata*)	August to October

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*Pollens of primary importance.

For index of States and other countries, see page 61

Rocky Mountain States

(Montana, Wyoming, Colorado, Utah, Idaho)

NAME	TIME OF BLOOM (Hay-Fever Season)
Black Walnut (*Juglans nigra*)	March to May
Cottonwood (*Populus macdougali*)	March to May
Oak (*Quercus alba*)	April to May
Rabbit Bush (*Franseria deltoidea*)	April to May
*Sweet Vernal Grass(*Anthoxanthum adoratum*)	April to July
Orchard Grass (*Dactylis glomerata*)	April to August
Sheep Sorrel (*Rumex acetosella*)	May to July
Yellow Dock (*Rumex crispus*)	May to July
*June Grass (Blue Grass, *Poa pratensis*)	May to September
*Timothy (*Phleum pratense*)	June to August
Lambs Quarters (*Chenopodium album*)	June to September
Annual Saltbush (*Atriplex Wrightii*)	July to September
Redroot Pigweed (*Amaranthus retroflexus*)	July to September
*Sage Brush (*Artemisia tridentata*)	July to September
Cocklebur (*Xanthium canadense*)	July to September
Mugwort (*Artemisia vulgaris*)	July to October
*Green Sage (*Artemisia canadensis*)	July to October
*Pasture Sage (*Artemisia frigida*)	July to October
Ragweed (*Ambrosia elatior*)	August to October
*Giant Ragweed (*Ambrosia trifida*)	August to October
*Western Ragweed (*Ambrosia psilostachya*)	August to October
Slender Ragweed (*Franseria tenuifolia*)	September to October

*Pollens of primary importance.

For index of States and other countries, see page 61

Southwestern States

(Southwestern Texas, New Mexico, Arizona, Southeastern California)

NAME	TIME OF BLOOM (Hay-Fever Season)
Mountain Cedar (*Juniperus sabinoides*)	December to February
The mountain cedar tree is found over a considerable part of Texas, Mexico and part of New Mexico	
*Cottonwood (*Populus macdougali*)	February to April
Arizona Walnut (*Juglans major*)	March to May
Arizona Ash (*Fraxinus toumeyi*)	March to May
*Shad Scale (*Atriplex canescens*)	March to June
Oak (*Quercus alba*)	April to May
*Rabbit Bush (*Franseria deltoidea*)	April to May
Olive (*Olea europaea*)	April to May
Sheep Sorrel (*Rumex acetosella*)	May to July
Yellow Dock (*Rumex crispus*)	May to July
*June Grass (Blue Grass, *Poa pratensis*)	May to September
*Bermuda Grass (*Capriola dactylon*)	May to September
Lambs Quarters (*Chenopodium album*)	June to September
Johnson Grass (*Sorghum halepense*)	June to October
*Annual Saltbush (*Atriplex Wrightii*)	July to September
*Redroot Pigweed (*Amaranthus retroflexus*)	July to September
Sage Brush (*Artemisia tridentata*)	July to September
Cocklebur (*Xanthium canadense*)	July to September
*Careless Weed (*Amaranthus palmeri*)	July to October
Green Sage (*Artemisia canadensis*)	July to October
Pasture Sage (*Artemisia frigida*)	July to October
Western Water Hemp (*Acnida tamariscina*)	July to October
Marsh Elder (*Iva ciliata*)	August to October
Western Ragweed (*Ambrosia psilostachya*)	August to October
*Slender Ragweed (*Franseria tenuifolia*)	September to October
Southwestern Ragweed (*Ambrosia aptera*)	September to October

*Pollens of primary importance.

For index of States and other countries, see page 61

Pacific States

(Nevada, California, Oregon, Washington)

NAME	TIME OF BLOOM (Hay-Fever Season)
Cottonwood (*Populus macdougali*)	February to April
*Black Walnut (*Juglans nigra*)	March to May

In California, this is much grown as a shade and ornamental tree in the Sacramento, Napa and Russian River Valleys where it is the most frequent cause of Spring hay-fever.

Shad Scale (*Atriplex canescens*)	March to June
Oak (*Quercus alba*)	April to May
Rabbit Bush (*Franseria deltoidea*)	April to May
*Olive (*Olea europaea*)	April to May
Sweet Vernal Grass (*Anthoxanthum odoratum*)	April to July
*Orchard Grass (*Dactylis glomerata*)	April to August

Apparently orchard grass is one of the most active of grass pollens occurring throughout the State of California, especially in meadows and pastures of the north, and extending through Oregon and Washington

*Perennial Rye Grass (*Lolium perenne*)	May to July

This grass is most important from San Francisco northward, and in Oregon

Sheep Sorrel (*Rumex acetosella*)	May to July
Yellow Dock (*Rumex crispus*)	May to July
*June Grass (Blue Grass, *Poa pratensis*)	May to September
*Bermuda Grass (*Capriola dactylon*)	May to September
*Timothy (*Phleum pratense*)	June to August

This is a very important cause of hay-fever in the northern and mountain counties of California, and in Oregon and Washington

*Redtop (*Agrostis palustris*)	June to September
Lambs Quarters (*Chenopodium album*)	June to September
*Johnson Grass (*Sorghum halepense*)	June to October
Annual Saltbush (*Atriplex Wrightii*)	July to September
*Redroot Pigweed (*Amaranthus retroflexus*)	July to September
*Sage Brush (*Artemisia tridentata*)	July to September
Cocklebur (*Xanthium canadense*)	July to September
*Mugwort (*Artemisia vulgaris*)	July to October

In California, the mugwort is the most frequent cause of the Fall type of hay-fever

*Careless Weed (*Amaranthus palmeri*)	July to October
Western Ragweed (*Ambrosia psilostachya*)	August to October
Slender Ragweed (*Franseria tenuifolia*)	September to October

*Pollens of primary importance.

For index of States and other countries, see page 61

The State of California may be sub-divided into three sections and the pollens of primary importance in these districts are as follows:

Ash tree (*Fraxinus toumeyi*)

San Francisco Bay District

Black Walnut, Orchard Grass, Perennial Rye Grass, June Grass, Bermuda Grass, Redroot Pigweed, Sagebrush, Mugwort.

Sacramento and San Joaquin Valleys

Olive, Black Walnut, Orchard Grass, Perennial Rye Grass, June Grass, Bermuda Grass, Redtop, Johnson Grass, Redroot Pigweed, Mugwort.

Ash blossoms (*Fraxinus toumeyi*)

Los Angeles-Pasadena District

Olive, Black Walnut, Orchard Grass, Perennial Rye Grass, June Grass, Bermuda Grass, Johnson Grass, Redroot Pigweed, Mugwort, Careless Weed.

Southwestern Area

As pointed out by WATSON and KIBLER,[18] the hay-fever problem in the Southwest is different and more

Black Walnut tree (*Juglans nigra*)

complex than in the other geographical sections of the country, owing to the difference in climatic con-

[18] WATSON, S. H. & KIBLER, C. S.: Etiology of Hay-Fever in Arizona and the Southwest, *Jour. A. M. A.*, Mar. 11, 1922, p. 719.

ditions. Rabbit bush and shad scale are probably the most important plants causing the spring type of hay-fever. Bermuda grass causes spring, summer

Black Walnut blossoms (*Juglans nigra*)

and fall type of hay-fever at altitudes up to 4500 feet and June grass (Bluegrass) above that altitude. The principal cause of fall hay-fever is usually care-

less weed, but some seasons this is replaced by annual saltbush. A less important cause of fall hay-fever is the slender ragweed.

Mountain Cedar tree (*Juniperus sabinoides*)

Hay-Fever in Other Countries

The important botanical groups of plants whose pollen is the direct cause of hay-fever in other countries of the world (exclusive of the United States) are as follows:

Alaska

Artemisia, Atriplex, Gramineae, Populus

Australia

Amaranthus, Atriplex, Chenopodium, Gramineae, Olea

British Isles

Amaranthus, Artemisia, Atriplex, Chenopodium, Fraxinus, Gramineae, Populus, Quercus, Rumex, Xanthium

Canadian Provinces

The important hay-fever pollens in the Canadian Provinces are similar to those listed under the groups of States which adjoin the Provinces.

By referring to the following table, the pollens that cause hay-fever in the various Provinces may readily be ascertained.

Nova Scotia	refer to New England States, page 40
Prince Edward Island	refer to New England States, page 40
New Brunswick	refer to New England States, page 40
Quebec	refer to New England States, page 40
Ontario	refer to Central States, page 43
Manitoba	refer to Middle Western States, page 44
Saskatchewan	refer to Rocky Mountain States, page 45
Alberta	refer to Rocky Mountain States, page 45
British Columbia	refer to Pacific States, page 47

For botanical species of hay-fever plants whose pollen is used in preparing Pollen Antigens (Lederle), see page 59

Central America

Amaranthus, Atriplex, Artemisia, Ambrosia, Chenopodium, Gramineae, Iva, Quercus, Xanthium

China

PLANT	TIME OF BLOOM
Populus	March
Fraxinus	April
Juglans	April
Quercus	April
Rumex	April to July
Gramineae:	
Poa	March to July
Agrostis	May to August
Capriola	May
Phleum	May
Sorghum	July
Amaranthus	June to July
Chenopodium	June to September

Hawaii

Amaranthus, Artemisia, Atriplex, Chenopodium, Franseria, Gramineae, Olea, Rumex, Xanthium

New Zealand

Amaranthus, Ambrosia, Atriplex, Artemisia, Chenopodium, Gramineae, Juglans, Olea, Quercus, Rumex, Xanthium

Of these, the Gramineae bloom as follows:

Anthoxanthum	August to October
Poa	September to October
Dactylis	October to November
Agrostis	November to December
Phleum	December to January

For botanical species of hay-fever plants whose pollen is used in preparing Pollen Antigens (Lederle), see page 59

Philippine Islands

Amaranthus, Artemisia, Chenopodium, Gramineae, Quercus

South Africa

Amaranthus, Artemisia, Atriplex, Chenopodium, Gramineae, Olea

South America

Amaranthus, Ambrosia, Artemisia, Atriplex, Chenopodium, Franseria, Gramineae, Juglans, Olea, Quercus, Xanthium

West Indies

Amaranthus, Ambrosia, Atriplex, Chenopodium, Fraxinus, Gramineae, Iva, Juglans, Olea, Xanthium

Western Europe

Amaranthus, Ambrosia, Artemisia, Atriplex, Chenopodium, Fraxinus, Gramineae, Juglans, Olea, Populus, Quercus, Xanthium

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For botanical species of hay-fever plants whose pollen is used in preparing Pollen Antigens (Lederle), see page 59

Chapter VII

List of Pollen Antigens (Lederle)

Pollen Antigens (Lederle) and Pollen Diagnostics, for the diagnosis and treatment of hay-fever, prepared from the pollens of the hay-fever plants listed below are now available.

	ILLUSTRATED ON PAGE
Annual Salt Bush (*Atriplex Wrightii*)	9
Arizona Ash (*Fraxinus toumeyi*)	48, 49
Arizona Walnut (*Juglans major*)	
Bermuda Grass (*Capriola dactylon*)	22
Black Walnut (*Juglans nigra*)	50, 51
Careless Weed (*Amaranthus palmeri*)	34, 35
Cocklebur (*Xanthium canadense*)	10, 13
Cottonwood (*Populus macdougali*)	38, 39
Grass, Bermuda (*Capriola dactylon*)	22
Grass, Johnson (*Sorghum halapense*)	23
Grass, June (*Poa Pratensis*)	17
Grass, Orchard (*Dactylis glomerata*)	20
Grass, Perennial Rye (*Lolium perenne*)	21
Grass, Redtop (*Agrostis palustris*)	19
Grass, Sweet Vernal (*Anthoxanthum odoratum*)	
Grass, Timothy (*Phleum pratense*)	18
Green Sage (*Artemisia canadensis*)	
Giant Ragweed (*Ambrosia trifida*)	4
Johnson Grass (*Sorghum halapense*)	23
June Grass (*Poa pratensis*)	17

(*List continued on next page*)

See tables on pages 40 to 47 for relative importance of the hay-fever plants in various sections of the country

List of Pollen Antigens (Lederle)—Continued

	ILLUSTRATED ON PAGE
Lambs Quarters (*Chenopodium album*)	24, 25
Marsh Elder (*Iva ciliata*)	7
Mountain Cedar (*Juniperus sabinoides*)	52
Mugwort (*Artemisia vulgaris*)	16
Oak (*Quercus alba*)	36, 37
Olive (*Olea europaea*)	
Orchard Grass (*Dactylis glomerata*)	20
Pasture Sage (*Artemisia frigida*)	
Perennial Rye Grass (*Lolium perenne*)	21
Rabbit Bush (*Franseria deltoidea*)	26, 27
Ragweed (*Ambrosia elatior*)	2, 3
Ragweed, Giant (*Ambrosia trifida*)	4
Ragweed, Slender (*Franseria tenuifolia*)	6
Ragweed, Southwestern (*Ambrosia aptera*)	
Ragweed, Western (*Ambrosia Psilostachya*)	5
Redroot Pigweed (*Amaranthus retroflexus*)	31
Redtop (*Agrostis palustris*)	19
Sage Brush (*Artemisia tridentata*)	14
Sage, Green (*Artemisia canadensis*)	
Sage, Pasture (*Artemisia frigida*)	
Shad Scale (*Atriplex canescens*)	8
Sheep Sorrel (*Rumex acetosella*)	28
Slender Ragweed (*Franseria tenuifolia*)	6
Southwestern Ragweed (*Ambrosia aptera*)	
Spiny Amaranth (*Amaranthus spinosus*)	30
Sweet Vernal Grass (*Anthoxanthum odoratum*)	
Timothy (*Phleum pratense*)	18
Walnut, Arizona (*Juglans major*)	
Walnut, Black (*Juglans nigra*)	50, 51
Western Ragweed (*Ambrosia Psilostachya*)	5
Western Water Hemp (*Acnida tamariscina*)	33
Yellow Dock (*Rumex crispus*)	29

See tables on pages 40 to 47 for relative importance of the hay-fever plants in various sections of the country.

Packages

All of the Pollen Antigens (Lederle) in the above list are supplied in the following packages:

Complete Series	$15.00
Series A, 5 doses (Nos. 1-5)	5.00
Series B, 5 doses (Nos. 6-10)	5.00
Series C, 5 doses (Nos. 11-15)	5.00
5 doses (No. 15)	5.00
3 Diagnostic Tests	Gratis

Note.—Pollen Antigens (Lederle) are supplied undiluted; each vial of glycerolated antigen contains an accurately measured dose and is accompanied by a vial of diluent. The dilution is made by transferring (with a sterile syringe) the diluent to the vial containing the Antigen. The physician makes the dilution at the moment of making the injection.

The Series A, B and C packages are provided for convenience in the treatment, during the pollinating season, of persons suffering with symptoms of hay-fever and for whom the full 15 doses may not be required. Whenever these Series packages are used, Series A should be used to begin the treatment. Series B and C ought to follow the regular sequence of dosage and should not be used to begin the treatment.

Botanical Species of Hay-Fever Plants

Pollens from the following species are used in the preparation of Pollen Antigens (Lederle).

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Acnida tamariscina (*Western Water Hemp*) 33
Agrostis palustris (*Redtop*) 19
Amaranthus palmeri (*Careless Weed*) 34, 35
Amaranthus retroflexus (*Redroot Pigweed*) 31
Amaranthus spinosus (*Spiny Amaranth*) 30
Ambrosia aptera (*Southwestern Ragweed*)
Ambrosia elatior (*Ragweed*) 2, 3
Ambrosia psilostachya (*Western Ragweed*) 5
Ambrosia trifida (*Giant Ragweed*) 4
Anthoxanthum odoratum (*Sweet Vernal Grass*)
Artemisia canadensis (*Green Sage*)
Artemisia frigida (*Pasture Sage*)
Artemisia tridentata (*Sage Brush*) 14
Artemisia vulgaris (*Mugwort*) 16
Atriplex canescens (*Shad Scale*) 8
Atriplex Wrightii (*Annual Saltbush*) 9
Capriola dactylon (*Bermuda Grass*) 22
Chenopodium album (*Lambs Quarters*) 24, 25
Dactylis glomerata (*Orchard Grass*) 20
Franseria deltoidea (*Rabbit Bush*) 26, 27
Franseria tenuifolia (*Slender Ragweed*) 6
Fraxinus toumeyi (*Arizona Ash*) 48, 49
Iva ciliata (*Marsh Elder*) 7
Juglans major (*Arizona Walnut*)
Juglans nigra (*Black Walnut*) 50, 51
Juniperus sabinoides (*Mountain Cedar*) 52
Lolium perenne (*Perennial Rye Grass*) 21

(*List continued on next page*)

Botanical Species of Plants—Continued

ILLUSTRATED ON PAGE

Olea europaea (*Olive*)
Phleum pratense (*Timothy*) 18
Poa pratensis (*June Grass*) 17
Populus macdougali (*Cottonwood*) 38, 39
Quercus alba (*Oak*) 36, 37
Rumex acetosella (*Sheep sorrel*) 28
Rumex crispus (*Yellow Dock*) 29
Sorghum halapense (*Johnson Grass*) 23
Xanthium canadense (*Cocklebur*) 10, 13

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By referring to the following pages, one may ascertain the pollens that cause hay-fever in the United States and other countries.

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